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Status of redfish in Subarea 2 + Division 3K

by

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[1]This series documents the scientific basis for the evaluation of fisheries resources in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

Abstract

The highest catch taken from this stock was 187,000 t in 1959. Between 1961 and 1986 catches averaged about 27,000 t, with no less than 14,500 t taken in any one year. Since 1986 catches declined from 18,500 t to 280 t in 1991 due primarily to a major redirection of effort to other redfish fisheries for the principal Canadian stakeholder. Most removals since 1991 are due to bycatch in the shrimp fisheries occuring in the area. Research surveys indicate the stock is at an extremely low level. There has been over 20 years of continuous recruitment failure since the strong year classes of the early 1970s. There has been nothing to indicate that the status of this stock will change in a positive way for at least 10 years.

Résumé

Les prises en provenance du stock considéré ont culminé à 187 000 t en 1959. Entre 1961 et 1986, elles se sont situées en moyenne autour de 27 000 t et n'ont jamais été inférieures à 14 500 t au cours d'une année quelconque. Elles ont ensuite diminué, passant de 18 500 t en 1986 à 280 t en 1991, en raison surtout d'une réorientation de l'effort vers d'autres populations de sébaste par le principal participant canadien. Depuis 1991, la plupart des retraits sont imputables aux prises accidentelles des pêcheurs de crevette qui pratiquent leur activité dans la région. Selon les relevés de recherche, le stock a atteint un niveau extrêmement bas. On assiste à une absence constante de recrutement depuis vingt ans, soit depuis l'apparition de fortes classes d'âge au début des années 1970. Rien n'indique que l'état du stock s'améliorera avant au moins dix ans.

Description of the fishery

The highest catch taken from this stock was 187,000 t in 1959 (Table 1, Fig. 1). Between 1961 and 1979 catches averaged about 30,000 t, ranging between 17,500 t and 56,000 t. From 1980-83 catches averaged 16,000 t, increased to about 27,000 t from 1984-1986 in response to improved markets and declined thereafter. There has not been a persistent directed effort on this stock since 1990 when 2,400 t were landed. Landings declined to 280 t in 1991, and have been less than 15 t in each year from 1992-1994. In addition, redfish discards from ship fisheries in the area amounted to 386 t, 185 t and 110 t in 1992, 1993 and 1994 respectively. Canada has accounted for most of the landings since the implementation of the 200-mile economic zone in 1977 (Table 2). The steady reduction since 1986 was due primarily to a major redirection of effort to other redfish fisheries. In addition there was no effort by foreign countries (Russia and Japan) fishing Canadian quotas since 1987.

In the 1980s, most of the landings were taken from Div. 3K. This was primarily due to the prevalence of external parasites in Div. 2J (see below). Throughout the existence of this fishery, the predominant fishing gear has been the bottom otter trawl.

The fishery has been under TAC regulation since 1974 when a 30,000 t quota was implemented. The TAC was increased to 35,000 t in 1980, decreased to 20,000 t in 1991 and further reduced to 1,000 t in 1994. For 1995, 200 t has been set aside for test fisheries.

Industry Experience

A number of reasons have been cited for the substantial reduction in landings since 1986 according to Canadian companies which had a directed fishery for this stock. First there was the continuous complaint of parasite infestation (Sphyrion lumpi, an external copepod which attaches itself to the flesh), particularly in Div. 2J. In addition there is a bacterial infection of the skin which also renders them undesirable for the prime market. Secondly, according to veteran trawler captains of this fishery, concentrations of fish had diminished on their traditional fishing grounds. Finally the major Canadian stakeholder, National Sea Products, had diverted effort to other fisheries because of the viability of the Div. 2J3K fishery. In early 1995, National Sea Products conducted a short experimental fishery in Div. 3K on traditional redfish grounds. Although only a few sets were conducted the results were very poor and the area steamed over was considered a desert in terms of viable concentrations of redfish.

Available Data

Commercial fishery data

There has been very limited data available since 1990 when this fishery virtually

became a by-catch fishery. In the mid-1980s prior to the decline in catches the bulk of the fishery consisted of fish in the 28-40 cm range which correspond to ages from 10-20 years.

Research survey data

Stratified random groundfish surveys have been conducted in the fall in Div. 2J and 3K since 1977. These surveys generally cover strata to depths of 1000m. The stratification scheme was redesigned for the 1993 survey to redefine stratum boundaries based on more recent information on depth soundings. Although it is difficult to compare the results of certain strata to those previous to 1993, in general the total area of revised stratification is only slightly different from the previous scheme used from 1977-1992.

The derived indices of stock size suggest the population in Div. 2J and Div. 3K are at historically low levels in 1994. Although there have been rather large fluctuations between some years in the both series, there has been a decline in the Div. 2J biomass index from about an average of 200,000 t from 1978-1981 to an average of 1,600 t from 1992-1994 (Tables 3-4). The Div. 3K biomass index suggests an even larger reduction from an average of 316,000 t from 1978-1981 to an average of 1,000 t from 1992-1994 (Tables 5-6). Average catch per tow was less than 2.2 kg in Div. 2J and less than 0.5 kg in Div. 3K since 1992 compared to an average of 182 kg and 150 kg respectively from 1978-1981 surveys (Fig. 2). Length distributions from the surveys in terms of mean number per tow at length (Fig. 3-4) indicate (1) that the stock is at a very low level and (2) recruitment has been extremely poor since the year classes of the early 1970s. The age classes currently comprising the stock are primarily those born since 1980 in the length range from 20 cm - 30 cm.

Stratified random groundfish surveys have been conducted occasionally in Div. 2G and 2H from 1978-1991. The information from these surveys suggests that the density and trawlable biomass of redfish in these areas was relatively low when compared to surveys in Div. 2J and 3K conducted in equivalent years (Power and Atkinson MS, 1990).

Greenland halibut directed surveys have also been conducted in Div. 3K in 1991, 1994 and 1995 during which redfish information was collected. The 1991 survey was a line transect survey conducted in September and the 1994 survey a stratified random design conducted in February-March. Both surveys covered depths from 750 m - 1500 m. The 1995 survey, conducted in March-April was also stratified random but had more extensive coverage from 500 m - 1500 m. Trawlable biomass was estimated about 4000 t in the 1991 survey, primarily due to one large set and there were no redfish caught in the 1994 survey (Morgan et al MS 1994). The trawlable biomass from the 1995 survey was about 1700 t.

It had been suggested previously that the timing and coverage of the fall Div. 2J3K surveys may not be optimum to fully understand the dynamics of the stock because distribution plots of Div. 2J3K survey catches indicated that in some years large concentrations of fish

were at the border of the surveyed area (Power and Atkinson MS 1990). The data from the Greenland Halibut surveys suggest that there was no large abundance of redfish missed because of distribution in deeper water in the 1991, 1993 and 1994 fall surveys to Div. 3K.

Mortality Rates

An approximation of an exploitation rate was derived by calculating a ratio of catch in year 'x' from Div. 2J3K to trawlable biomass from the fall surveys in year 'x-1' as an estimate of stock size at the beginning of the year. The results (Table 7, Fig. 5) suggest that exploitation on this stock has been above 12% only in 1985 (18%) and 1986 (18%) and has generally been below 6%, which for redfish is considered to be below the $F_{0.1}$ level (F=.12 or 11%) based on yield per recruit calculations from neighboring Div. 3LN (ANON 1989).

Summary and Prognosis

It is not possible to provide an estimate of the absolute size of this stock. The estimates of trawlable biomass from surveys in Div. 2J and Div. 3K combined indicate the population has declined from an average of 516,000 t from 1978-1981 to an average of 2,600 t from 1992-1994. The exploitation rate generated from catches over this time period cannot totally account for the decline in the biomass since the late 1970s even though there has been over 20 years of recruitment failure.

There is a strong concern regarding the current state of this stock and an even stronger concern about the future because of recruitment failure since the year classes of the early 1970s. From a conservation point of view, exploitation of this stock is unjustifiable. There has been nothing to indicate that the status of this stock will change in a positive way in the forseeable future. Any good recruitment coming into this stock will need at least 10 years before it will start contributing to a fishery because of the relatively slow growth rate of redfish.

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Table 1. Summary of nominal catches (t) of redfish in SA2 + Div. 3K.

Year	2G	2H	2J	3K	Total	TAC
1959	-	23	52,519	134,065	186,837[a]	
1960	-	56	80,292	45,698	126,164[a]	
1961	-	542	25,052	29,861	55,465[a]	
1962	-	155	7,576	11,925	19,659[a]	
1963	245	16	5,873	17,510	28,898[a]	
1964	120	938	16,001	23,044	56,232[a]	
1965	1,103	2,878	19,516	20,042	43,539	
1966	197	4,678	9,135	18,720	32,730	
1967	24	3,327	13,699	9,112	26,162	
1968	670	3,156	4,938	10,104	18,908[a]	
1969	177	869	7,128	16,407	24,635[a]	
1970	90	501	8,372	12,834	21,819[a]	
1971	471	1,079	5,084	12,672	19,312[a]	
1972	22	637	8,879	10,495	20,033	
1973	192	742	10,545	27,486	38,965	30,000
1974	85	429	5,943	23,688	30,145	30,000
1975	67	383	14,096	11,013	25,559	30,000
1976	89	1,606	14,412	9,858	25,965	30,000
1977	99	770	6,509	10,161	17,539	30,000
1978	29	554	11,804	16,759	29,146	30,000
1979	14	256	16,659	13,801	30,730	30,000
1980	2	47	4,423	10,047	14,519	35,000
1981	24	203	4,241	13,174	17,642	35,000
1982	-	583	7,048	10,352	17,983	35,000
1983	-	158	2,166	12,987	15,311	35,000
1984	49	81	2,329	21,230	23,689	35,000
1985	-	133	867	28,225	29,225	35,000
1986	-	69	3,456	23,494	27,019	35,000
1987	-	16	3,212	15,283	18,511	35,000
1988	8	28	994	5,912	6,942	35,000
1989	1	3	79	3,084	3,287[a]	35,000
1990	2	-	316	2,104	2,422	35,000
1991	-	1	8	271	280	20,000
1992	-	-	1	14	401[c]	20,000
1993[b]	-	-	-	2	187[c]	20,000
1994[b]	-	-	-	1	111[c]	1,000
1995	-	-	-	-	-	200

[a]Totals include catch in SA2 + Div. 3K which could not be identified by division.
[b]Provisional.
[c]Includes estimates of discards from shrimp fisheries in SA2 + Div. 3K.

Table 2. Nominal catches (t) of redfish in Subarea 2 + Division 3K by country and year.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[a]	1993[a]	1994[a]
Can (N)	7,350	5,413	12,298	14,863	10,933	8,719	4,437	1,594	1,806	161	9	2	1
Can (M)	3,784	3,384	5,069	6,716	7,860	3,429	923	585	242	10	-	-	-
DDR	425	626	485	101	134	378	-	-	-	-	-	-	-
Faroes	-	-	-	-	-	16	-	-	-	-	-	-	-
France (Metro)	9	-	2	9	5	3	-	120	-	-	-	-	-
FRG	180	77	111	204	63	65	-	-	-	-	-	-	-
Japan	2,662	-	1,218	3,471	4,178	2,127	698	489	239	66	-	-	-
Norway	-	-	-	-	1	-	-	-	-	42	-	-	-
Poland	24	1,406	366	66	297	41	36	8	-	-	-	-	-
Portugal	456	183	437	106	20	-	-	-	-	-	-	-	-
UK	20	-	13	-	-	-	-	-	-	-	-	-	-
Russia	3,073	3,722	3,690	3,689	3,528	3,733	848	491	134	1	6	-	-
Total	17,983	15,311	23,689	29,225	27,019	18,511	6,942	3,287	2,421	280	15	2	1

[a]Provisional.

Table 3. Mean weight of redfish caught per standard tow in Division 2J during Canadian research surveys, 1978-92. Numbers in brackets are number of successful sets, "(*)" indicates those strata estimated with a multiplicative model (MA).

Stratum	Area (mi^2)	Depth range (m)	1978	1979	1980	1981	1982	1983	1984	1985	1986
203	480	301-400	1.34(2)	0.68(2)	3.25(2)	0.75(2)	2..40(3)	1.48(3)	3.75(2)	0.08(3)	0.30(2)
204	354	401-500	5.66(2)	7.03(2)	1.00(1)	3.40(2)	0.43(3)	2.63(3)	5.00(2)	0.00(2)	0.15(2)
208	448	301-400	42.39(2)	1540.40(2)	17.75(2)	26.00(2)	7.17(3)	2.85(2)	20.00(3)	11.50(3)	0.15(2)
209	1608	201-300	0.06(2)	0.00(2)	3.70(2)	0.50(6)	0.00(11)	0.13(7)	0.09(7)	0.11(9)	0.00(7)
210	774	201-300	1.51(3)	3.17(2)	1.00(2)	0.00(3)	2.91(6)	0.75(2)	2.00(4)	0.02(4)	0.07(3)
211	330	301-400	18.82(3)	19.29(2)	46.00(2)	987.00(2)	13.75(2)	0.10(2)	38.25(3)	64.75(3)	0.88(2)
212	664	501-750	3.40(2)	4.77(2)	0.55(2)	2.80(2)	3.40(5)	2.65(3)	9.00(2)	1.64(4)	2.63(3)
213	1725	201-300	55.04(3)	85.88(3)	0.43(3)	2.79(6)	4.60(10)	92.82(10)	42.30(5)	0.96(9)	0.00(9)
214	1171	201-300	75.15(3)	4.54(2)	0.00(2)	54.14(5)	28.19(8)	32.02(8)	0.38(4)	0.67(6)	1.62(6)
215	1270	201-300	9.61(3)	6.01(2)	7.50(2)	1.20(5)	0.41(9)	1.66(8)	2.27(3)	0.17(6)	1.40(5)
216	384	301-400	2209.48(2)	267.74(2)	590.17(2)	69.50(2)	195.75(2)	133.67(3)	272.50(2)	70.55(2)	227.14(2)
217	268	401-500	704.90(2)	164.29(2)	470.57(2)	73.75(2)	214.00(2)	239.83(2)	246.72(*)	73.50(2)	181.63(2)
218	420	501-750	611.68(2)	240.28(*)	314.50(2)	92.00(2)	55.50(2)	99.25(2)	213.21(*)	41.25(2)	44.25(2)
219	213	751-1000	16.33(1)	5.67(*)	4.66(*)	8.00(2)	3.37(*)	1.90(2)	4.98(*)	0.00(2)	14.70(2)
222	441	301-400	1331.48(2)	302.99	402.50(2)	1033.75(2)	582.00(3)	963.48(3)	303.30(3)	152.50(2)	47.10(2)
223	180	201-300	1131.28(2)	221.87(2)	538.50(2)	459.16(2)	358.16(2)	271.00(2)	247.00(2)	328.75(2)	606.75(2)
224	270	501-750	836.89(2)	425.01(2)	293.25(2)	204.75(2)	99.00(2)	110.75(2)	114.50(2)	26.25(2)	151.35(2)
227	686	401-500	714.01(2)	148.46(2)	159.24(2)	8.00(2)	99.90(5)	70.88(4)	57.33(3)	45.50(4)	199.22(3)
228	1428	201-300	27.97(3)	3.34(2)	437.45(2)	1548.50(6)	31.60(10)	103.54(6)	88.44(7)	0.01(7)	17.93(6)
229	567	301-400	69.61(2)	181.37(2)	285.30(2)	769.25(2)	432.87(4)	364.08(4)	131.83(3)	50.17(3)	321.50(3)
230	237	501-750	1160.53(2)	267.72(*)	196.52(2)	79.75(2)	134.15(2)	74.50(2)	63.25(2)	72.00(2)	326.50(2)
231	182	751-1000	0.00(2)	6.08(*)	3.00(2)	11.00(1)	3.50(2)	2.25(2)	17.75(2)	9.75(2)	6.15(2)
235	420	401-500	2.95(2)	17.02(2)	23.50(2)	4.25(2)	6.17(3)	13.25(2)	38.00(3)	5.00(2)	1.00(2)
236	122	751-1000	7.73(*)	4.81(*)	3.94(*)	3.75(2)	2.75(3)	3.00(2)	4.75(2)	12.50(2)	6.30(2)
Mean			231.35	115.08	125.32	257.34	65.15	88.34	58.38	21.19	51.82
Total (MT)			254278	126484	137742	282841	71603	97088	64161	23290	56954

Table 3 (Cont'd.).

Stratum	Area (mi^2)	Depth range (m)	1987	1988	1989	1990	1991	1992
203	480	301-400	0.03(3)	0.00(2)	0.54(3)	0.00(2)	0.00(3)	0.00(3)
204	354	401-500	0.00(2)	0.25(2)	0.59(2)	2.22(2)	0.55(3)	0.10(3)
208	448	301-400	0.55(2)	1.20(2)	1.65(2)	0.00(2)	0.14(3)	0.73(3)
209	1608	201-300	0.03(8)	0.00(5)	0.00(8)	0.00(6)	0.00(7)	0.00(5)
210	774	201-300	0.22(4)	0.50(3)	0.00(4)	0.00(3)	0.05(7)	0.16(7)
211	330	301-400	3.50(2)	1.10(2)	2.41(2)	0.68(2)	0.36(5)	0.30(6)
212	664	501-750	0.84(4)	0.00(2)	0.21(4)	0.74(3)	4.75(2)	1.08(2)
213	1725	201-300	0.45(9)	0.41(8)	0.00(9)	0.12(8)	0.08(14)	0.01(19)
214	1171	201-300	1.55(6)	2.70(6)	0.16(6)	0.22(5)	0.11(15)	0.16(14)
215	1270	201-300	0.31(7)	0.10(7)	0.11(6)	0.21(6)	0.05(15)	0.21(10)
216	384	301-400	141.50(2)	50.00(2)	8.43(2)	3.05(2)	2.50(3)	1.67(3)
217	268	401-500	92.50(2)	272.75(2)	20.17(2)	22.63(2)	4.90(3)	13.83(3)
218	420	501-750	194.00(2)	245.75(2)	53.95(2)	24.80(2)	3.42(2)	27.30(2)
219	213	751-1000	0.20(2)	1.50(2)	0.00(2)	2.60(2)	0.00(2)	0.69(2)
222	441	301-400	63.00(2)	1064.29(2)	6.18(2)	1.85(2)	0.42(3)	1.83(3)
223	180	201-300	76.25(2)	449.25(2)	28.70(2)	7.38(2)	6.59(2)	4.79(3)
224	270	501-750	138.00(2)	326.25(2)	9.83(2)	5.63(2)	6.95(2)	9.57(2)
227	686	401-500	38.88(4)	4.97(3)	5.18(4)	105.45(3)	5.03(6)	5.59(6)
228	1428	201-300	6.60(7)	5.80(5)	1.57(8)	1.10(6)	0.66(3)	0.24(5)
229	567	301-400	6.67(3)	2.13(3)	26.08(3)	3.30(2)	1.51(3)	1.48(3)
230	237	501-750	151.00(2)	50.25(2)	80.28(2)	140.98(2)	25.18(2)	14.98(2)
231	182	751-1000	1.55(2)	5.30(2)	0.83(1)	0.00(2)	0.74(2)	2.05(2)
235	420	401-500	8.50(2)	15.32(2)	1.37(2)	52.38(2)	4.50(3)	1.05(3)
236	122	751-1000	2.35(2)	0.00(2)	0.03(*)	0.43(2)	0.00(2)	1.60(2)
Mean			22.16	59.54	5.78	10.61	1.65	2.16
Total (MT)			24351	65435	6355	11661	1810	2369

Table 4. Mean weight of redfish caught per standard tow in Division 2J during Canadian research surveys from 1993 to 1994. The stratification scheme utilized was revised for the 1993 survey. Numbers in brackets are number of successful sets. '-NS-' = not sampled.

Stratum	Area (mi^2)	Depth range (m)	1993	1994
203	487	301-400	0.12(2)	0.00(2)
204	288	401-500	0.06(2)	0.44(3)
208	588	301-400	0.00(2)	0.00(3)
209	680	201-300	0.00(3)	0.00(2)
210	1035	201-300	0.00(4)	0.00(6)
211	251	301-400	0.00(2)	0.00(3)
212	557	501-750	1.27(2)	0.40(3)
213	1583	201-300	0.02(6)	0.36(3)
214	1341	201-300	0.00(5)	0.04(6)
215	1302	201-300	0.09(5)	0.01(5)
216	360	301-400	0.82(2)	0.12(2)
217	241	401-500	5.23(2)	6.47(3)
218	362	501-750	7.65(2)	9.38(2)
219	283	751-1000	4.30(2)	0.20(2)
220	303	1001-1250	-NS-	-NS-
221	330	1251-1500	-NS-	-NS-
222	450	301-400	0.36(2)	1.15(3)
223	158	201-300	4.78(2)	1.08(3)
224	228	501-750	18.00(2)	12.42(3)
225	195	1001-1250	-NS-	-NS-
226	201	1251-1500	-NS-	-NS-
227	598	401-500	3.41(3)	1.21(5)
228	2196	201-300	0.02(9)	0.14(3)
229	536	301-400	1.08(2)	0.00(3)
230	185	501-750	2.65(2)	20.78(3)
231	186	751-1000	1.28(2)	1.23(3)
232	228	1001-1250	-NS-	-NS-
233	237	1251-1500	-NS-	-NS-
235	414	401-500	1.01(3)	2.60(3)
236	193	751-1000	2.10(2)	0.30(3)
239	120	501-750	0.03(2)	0.01(3)
240	133	401-500	2.17(2)	2.60(3)
Mean			1.08	1.09
Total (MT)			1201	1211

Table 5. Mean weight of redfish caught per standard tow in Division 3K during Canadian research surveys, 1978-92. Numbers in brackets are number of succesaful sets, "(*)" indicates those strata estimated with a multiplicative model (MA).

Stratum	Area (mi^2)	Depth range (m)	1978	1979	1980	1981	1982	1983	1984	1985	1986
620	2709	201-300	13.68(5)	2.34(3)	2.17(3)	1.83(10)	0.05(9)	2.00(10)	0.07(13)	0.09(14)	0.00(9)
621	2859	201-300	0.83(5)	0.68(3)	2.90(3)	0.57(11)	0.15(14)	0.00(12)	0.07(14)	0.11(15)	0.04(14)
622	632	401-500	7.26(2)	3.33(3)	5.75(2)	16.25(2)	14.17(3)	14.00(2)	5.50(4)	1.04(4)	1.75(2)
623	1027	301-400	6.50(3)	13.60(1)	32.25(2)	2.46(4)	2.80(5)	84.17(6)	5.40(5)	2.67(6)	0.55(4)
624	668	201-300	82.17(4)	13.61(2)	5.00(2)	1.75(2)	1.47(4)	0.63(4)	5.05(4).	0.69(4)	0.85(2)
625	850	301-400	35.90(3)	16.33(2)	54.25(2)	303.50(4)	4.00(2)	219.00(3)	8.30(5)	23.12(5)	0.20(3)
626	919	301-400	51.86(3)	13.15(2)	27.50(2)	77.28(5)	19.36(5)	2.75(4)	2.60(6)	14.73(5)	0.40(4)
627	1194	401-500	2.72(2)	7.87(3)	10.75(2)	2.96(6)	4.21(7)	10.57(6)	4.66(8)	0.74(7)	0.54(5)
628	1085	301-400	47.17(2)	54.46(3)	9.75(2)	16.82(6)	3.13(6)	11.41(6)	7.67(7)	1.34(6)	0.00(4)
629	495	301-400	234.51(3)	53.49(*)	65.00(2)	28.33(3)	12.50(2)	974.00(3)	7.69(4)	7.42(4)	3.60(3)
630	544	301-400	212.17(2)	56.69(2)	20.50(2)	6.25(2)	8.76(*)	36.74(2)	114.03(3)	14.87(4)	13.90(2)
631	1202	401-500	6.14(2)	9.31(3)	16.90(3)	5.80(5)	2.50(2)	23.00(5)	140.12(5)	73.09(7)	4.32(4)
632	447	201-300	59.02(4)	6.47(2)	90.75(2)	9.00(2)	4.17(3)	9.83(3)	5.00(1)	2.87(3)	2.00(2)
633	2179	301-400	1496.14(4)	35.16(4)	137.00(3)	56.64(8)	508.52(7)	295.39(12)	62.45(10)	364.25(12)	15.05(8)
634	1618	201-300	84.91(4)	7.25(2)	33.50(2)	7.07(7)	42.54(11)	2293.60(5)	18.61(7)	9.74(9)	17.44(5)
635	1274	201-300	88.22(4)	159.42(3)	12.50(2)	1192.00(5)	2.46(5)	2.30(6)	18.52(8)	4.57(7)	0.77(6)
636	1455	201-300	239.67(4)	24.04(2)	2362.43(2)	11.00(6)	19.05(10)	72.50(6)	4.92(8)	3.91(8)	3.35(4)
637	1132	201-300	82.55(5)	232.38(3)	29.50(2)	336.37(6)	18.21(7)	139.22(5)	5.02(6)	25.94(7)	3.25(4)
638	2059	301-400	115.88(3)	102.60(2)	260.10(3)	44.31(8)	33.06(10)	65.57(11)	72.85(10)	47.00(11)	7.40(4)
639	1463	301-400	352.23(4)	863.46(2)	280.00(2)	28.05(6)	177.42(15)	1903.69(7)	329.92(8)	232.81(8)	786.50(6)
640	198	401-500	488.50(2)	190.36(*)	476.25(2)	181.50(2)	191.50(2)	287.59(*)	96.00(2)	257.41(3)	57.00(2)
641	584	501-750	370.58(2)	84.61(2)	228.00(2)	98.00(2)	88.38(4)	34.50(3)	54.00(3)	47.63(4)	14.91(*)
642	931	751-1000	0.57(2)	1.82(1)	3.00(2)	0.67(3)	1.67(6)	4.24(*)	2.79(6)	4.20(5)	0.05(*)
645	204	401-500	746.60(2)	360.51(*)	503.70(2)	204.25(2)	249.00(3)	623.50(2)	51.25(2)	468.74(3)	63.16(*)
646	333	501-750	1398.40(2)	13.16(2)	77.00(2)	103.25(2)	684.00(2)	512.00(2)	313.00(2)	153.17(3)	28.72(*)
647	409	751-1000	16.60(2)	0.27(2)	12.35(2)	2.50(2)	0.25(2)	0.80(1)	28.50(1)	145.33(3)	0.66(*)
Mean			220.26	85.47	189.73	96.70	69.71	308.00	45.22	60.32	45.60
Total (MT)			470721	182658	405461	206661	148970	658226	96637	128909	97445

Table 5 (Cont'd.).

Stratum	Area (mi^2)	Depth range (m)	1987	1988	1989	1990	1991	1992
620	2709	201-300	0.10(14)	0.01(12)	0.09(15)	0.00(9)	0.06(14)	0.00(3)
621	2859	201-300	0.02(12)	0.02(10)	0.00(17)	0.02(11)	0.03(5)	0.00(3)
622	632	401-500	0.40(3)	0.07(3)	1.02(3)	0.68(2)	0.36(3)	0.41(3)
623	1027	301-400	0.22(5)	0.76(5)	0.37(6)	0.23(6)	0.48(6)	0.55(3)
624	668	201-300	0.13(3)	0.17(3)	0.03(3)	0.21(4)	0.00(2)	0.01(3)
625	850	301-400	11.27(4)	0.25(4)	1.08(4)	0.12(4)	0.29(3)	0.00(3)
626	919	301-400	2.58(5)	0.06(4)	196.36(5)	0.00(4)	0.45(3)	0.04(3)
627	1194	401-500	0.48(6)	0.22(6)	11.74(6)	3.05(6)	0.03(3)	0.25(3)
628	1085	301-400	0.50(5)	0.27(5)	0.18(4)	0.00(5)	0.03(3)	0.00(3)
629	495	301-400	9.35(3)	4.50(2)	1.33(3)	1352.63(2)	0.81(4)	0.23(3)
630	544	301-400	1.27(3)	0.03(3)	0.54(3)	0.27(2)	0.38(3)	0.45(3)
631	1202	401-500	3.08(6)	3.58(6)	5.67(7)	0.41(6)	1.78(6)	3.57(3)
632	447	201-300	0.60(2)	3.05(2)	0.60(2)	0.40(2)	0.49(10)	0.50(13)
633	2179	301-400	7.85(11)	8.95(8)	4.21(10)	13.99(11)	52.51(25)	0.59(25)
634	1618	201-300	4.01(11)	3.45(6)	4.00(7)	0.68(7)	0.73(25)	0.05(25)
635	1274	201-300	1.35(6)	0.26(5)	19.51(7)	1.07(6)	0.01(4)	0.13(3)
636	1455	201-300	1.43(7)	1.66(6)	0.68(5)	0.15(7)	0.28(3)	0.01(3)
637	1132	201-300	0.77(6)	2.42(8)	0.88(5)	0.20(5)	0.37(6)	0.00(3)
638	2059	301-400	58.70(10)	553.31(8)	15.43(11)	119.55(9)	1.89(25)	0.19(25)
639	1463	301-400	75.56(7)	57.70(6)	11.94(8)	131.22(7)	4.72(3)	0.30(25)
640	198	401-500	96.25(2)	131.00(2)	14.28(2)	25.02(2)	8.30(3)	1.25(3)
641	584	501-750	30.17(3)	13.07(*)	13.51(*)	13.13(2)	11.85(2)	1.36(2)
642	931	751-1000	1.00(5)	0.00(*)	0.00(*)	1.52(3)	0.00(2)	0.59(2)
645	204	401-500	210.75(2)	210.50(2)	619.98(2)	57.55(2)	14.42(3)	3.87(3)
646	333	501-750	255.50(2)	25.24(*)	26.07(*)	5.95(2)	44.60(3)	12.73(3)
647	409	751-1000	1.20(1)	0.52(*)	0.56(*)	6.94(2)	11.64(3)	0.33(3)
Mean			15.77	47.39	15.55	41.35	5.73	0.53
Total (MT)			33711	101272	33234	88358	12235	1135

Table 6. Mean weight of redfish caught per standard tow in Division 3K during Canadian research surveys from 1993 to 1994. The stratification scheme utilized was revised for the 1993 survey. Numbers in brackets are number of successful sets. '-NS-' = not sampled.

Stratum	Area (mi^2)	Depth range (m)	1993	1994
617	593	301-400	0.06(3)	0.09(4)
620	2545	201-300	0.00(3)	0.00(5)
621	2736	201-300	0.00(3)	0.00(3)
622	691	401-500	0.33(4)	0.22(5)
623	494	301-400	0.12(4)	0.0093)
624	1105	201-300	0.05(7)	0.00(3)
625	888	301-400	0.43(3)	0.12(3)
626	1113	301-400	0.00(3)	0.00(3)
627	1255	401-500	0.13(3)	0.16(8)
628	1085	301-400	0.07(3)	0.00(6)
629	425	301-400	0.02(3)	0.30(4)
630	332	301-400	0.00(3)	0.05(3)
631	1321	401-500	0.14(3)	0.26(4)
633	2067	301-400	0.16(18)	0.39(5)
634	1555	201-300	0.21(16)	0.34(4)
635	1274	201-300	0.15(3)	0.00(4)
636	1455	201-300	0.06(3)	0.00(3)
637	1132	201-300	0.00(3)	0.00(14)
638	2059	301-400	0.26(20)	0.10(21)
639	1463	301-400	0.36(15)	0.64(8)
640	69	401-500	4.07(3)	3.67(3)
641	230	501-750	6.45(3)	4.87(3)
642	418	751-1000	0.79(3)	0.10(3)
643	733	1001-1250	-NS-	-NS-
644	474	1251-1500	-NS-	-NS-
645	216	401-500	4.12(3)	4.25(3)
646	325	501-750	5.82(3)	10.21(3)
647	360	751-1000	0.54(3)	4.85(3)
648	228	1001-1250	-NS-	-NS-
649	212	1251-1500	-NS-	-NS-
650	134	401-500	3.17(3)	2.16(4)
651	359	501-750	2.61(3)	3.21(4)
652	516	751-1000	1.67(3)	0.04(4)
653	531	1001-1250	0.12(3)	-NS-
654	479	1251-1500	-NS-	-NS-
Mean			0.40	0.44
Total (MT)			860	928

Table 7. Estimates of exploitation rate derived by calculating a ratio of catch in year 'x in Division 2J3K to trawlable biomass in year "x-1" from fall surveys.

Year	Trawlable biomass (metric tons)	Catch (metric tons)	Exploitation (%)
1978	724999		
1979	309142	30460	4.20
1980	543203	14470	4.68
1981	489502	17415	3.21
1982	220573	17400	3.55
1983	755314	15153	6.87
1984	160798	23559	3.12
1985	152199	29092	18.09
1986	154399	26950	17.71
1987	58062	18495	11.98
1988	166707	6906	11.89
1989	39589	3283	1.97
1990	100019	2420	6.11
1991	14045	279	0.28
1992	3504	401	2.86
1993	2061	187	5.34
1994		111	5.39

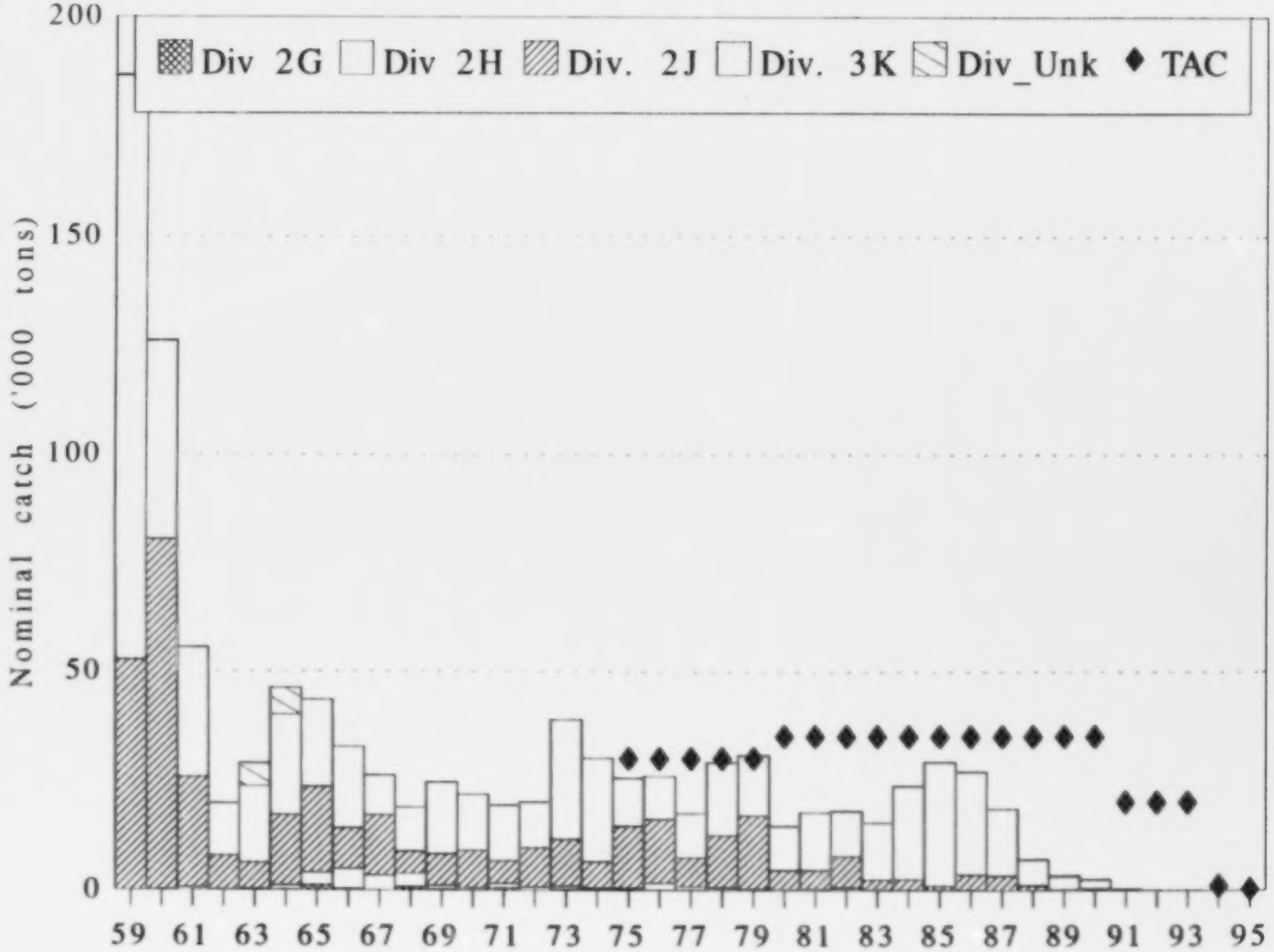

Fig. 1. Nominal catches (t) and TACs of redfish in SA2 + Div.3K. (1992-94 catches are provisional).

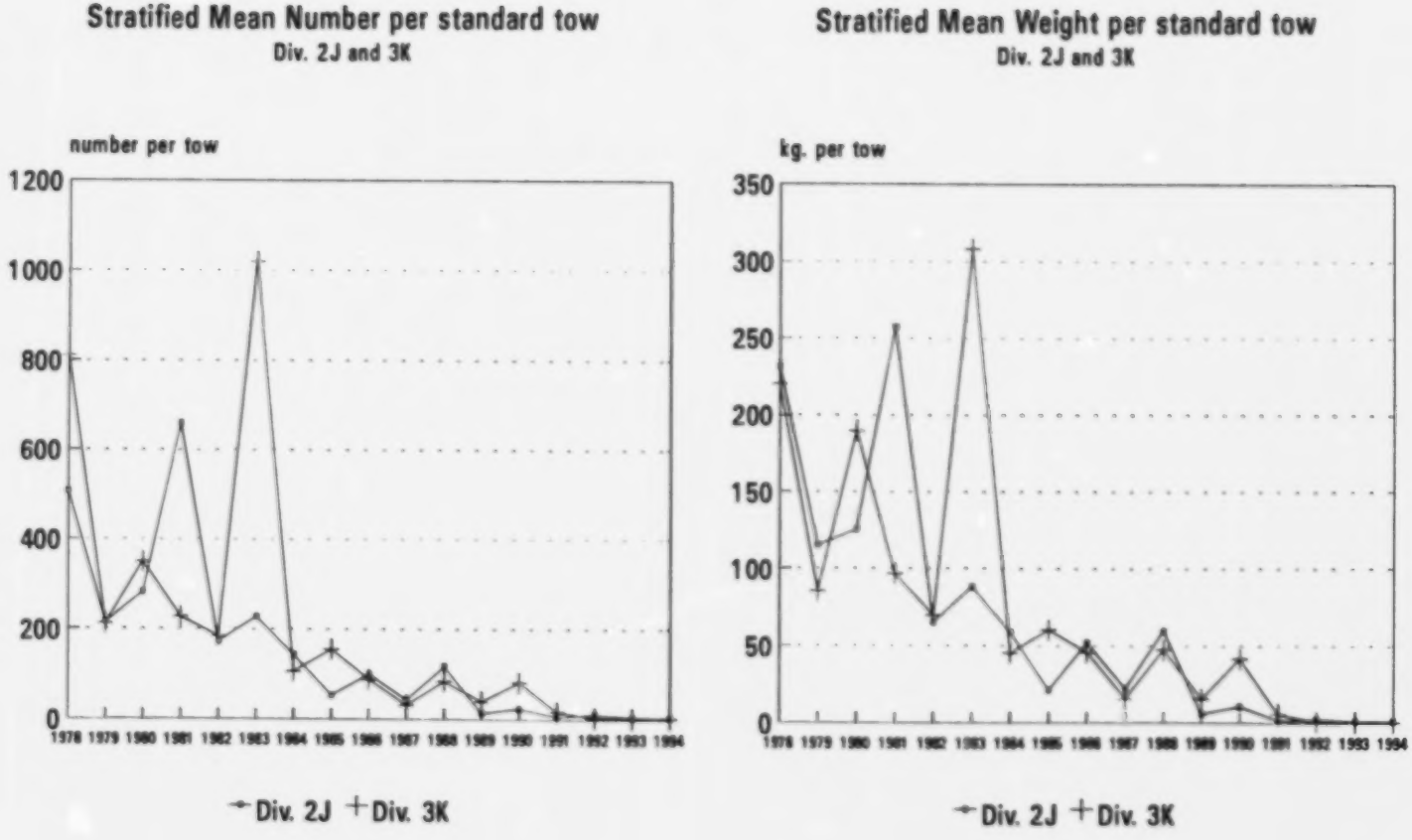

Fig. 2. Stratified mean numbers and weight (kg) per standard tow in Div. 2J and Div. 3K. In certain years unsampled strata were estimated with a multiplicative model.

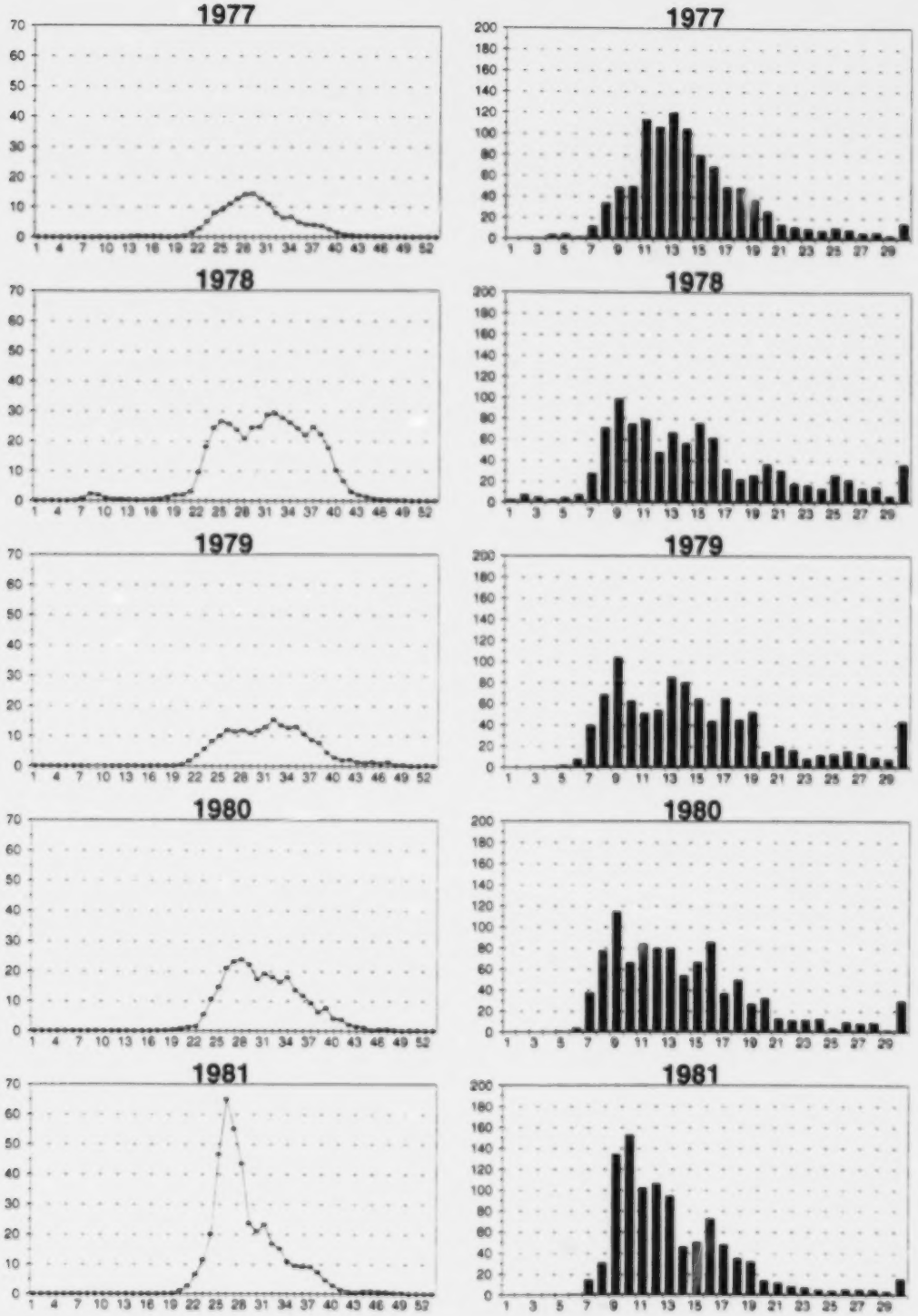

Fig. 3. Length frequencies and corresponding age distribution from stratified-random research surveys to Div. 2J from 1977-1994. Plotted above are mean number per standard tow (left) and corresponding number per thousand age distribution (right). X-axis is forklength in centimetres for left plot, and age in years for right plot.

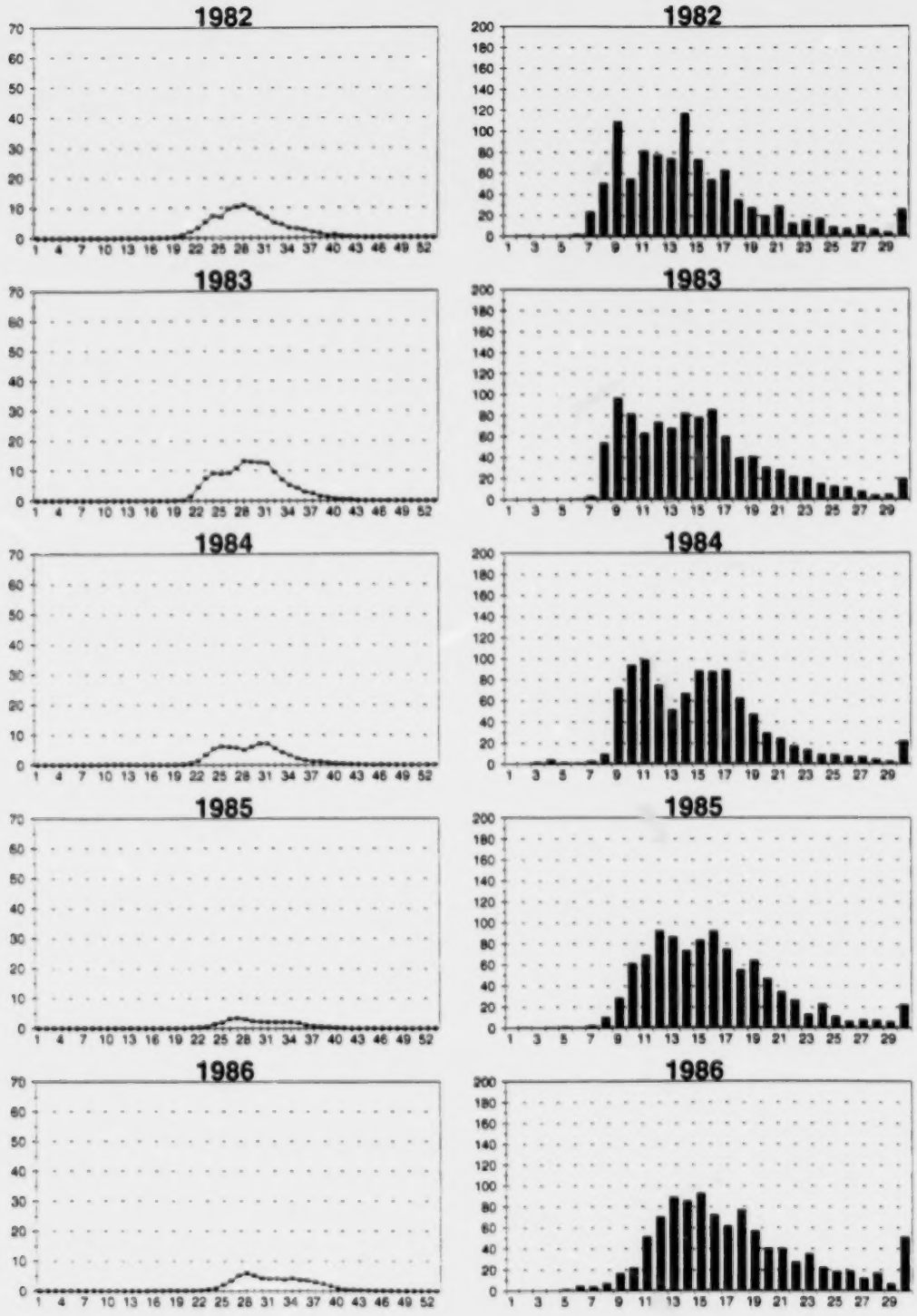

Fig. 3. (continued)

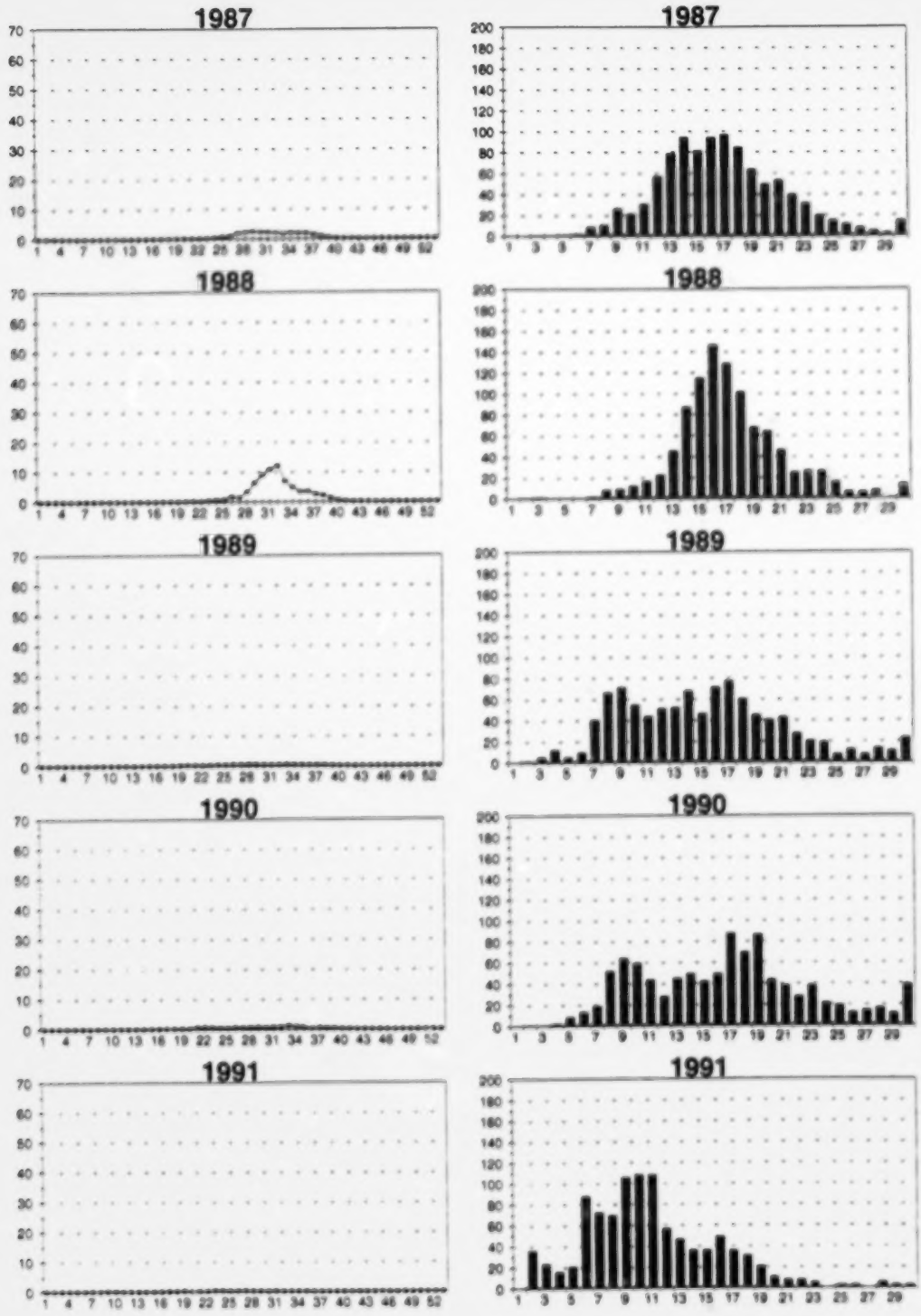

Fig. 3. (continued)

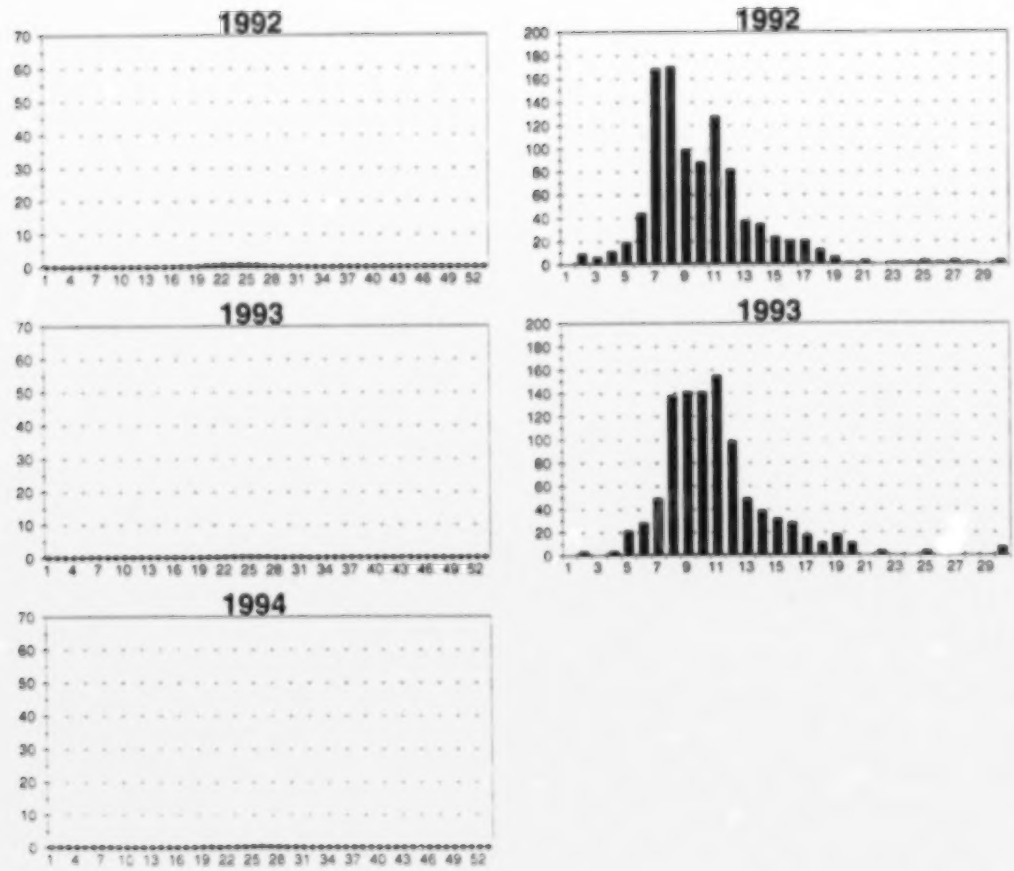

Fig. 3. (continued)

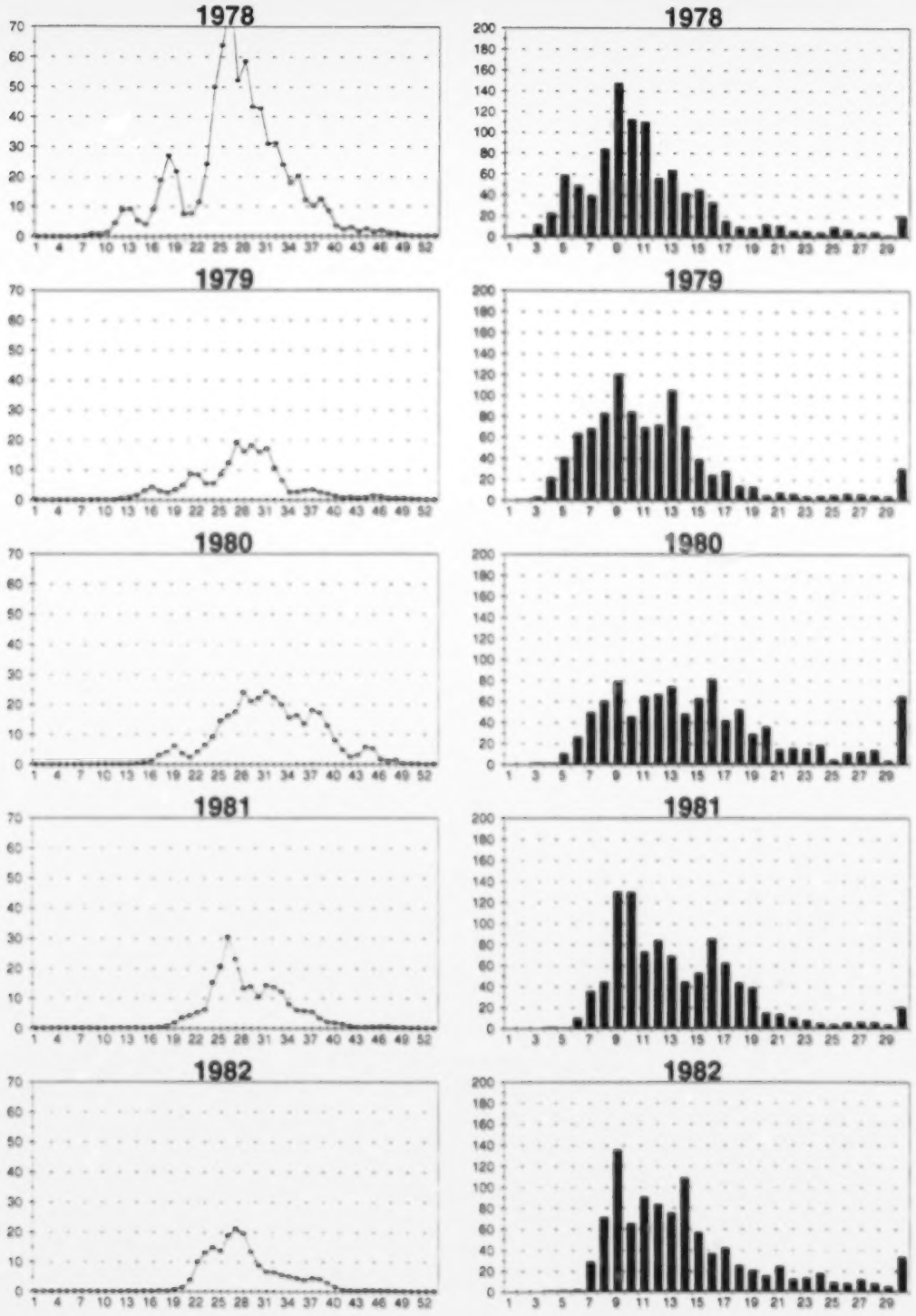

Fig. 4. Length frequencies and corresponding age distribution from stratified-random research surveys to Div. 3K from 1978-1994. Plotted above are mean number per standard tow (left) and corresponding number per thousand age distribution (right). X-axis is forklength in centimetres for left plot, and age in years for right plot.

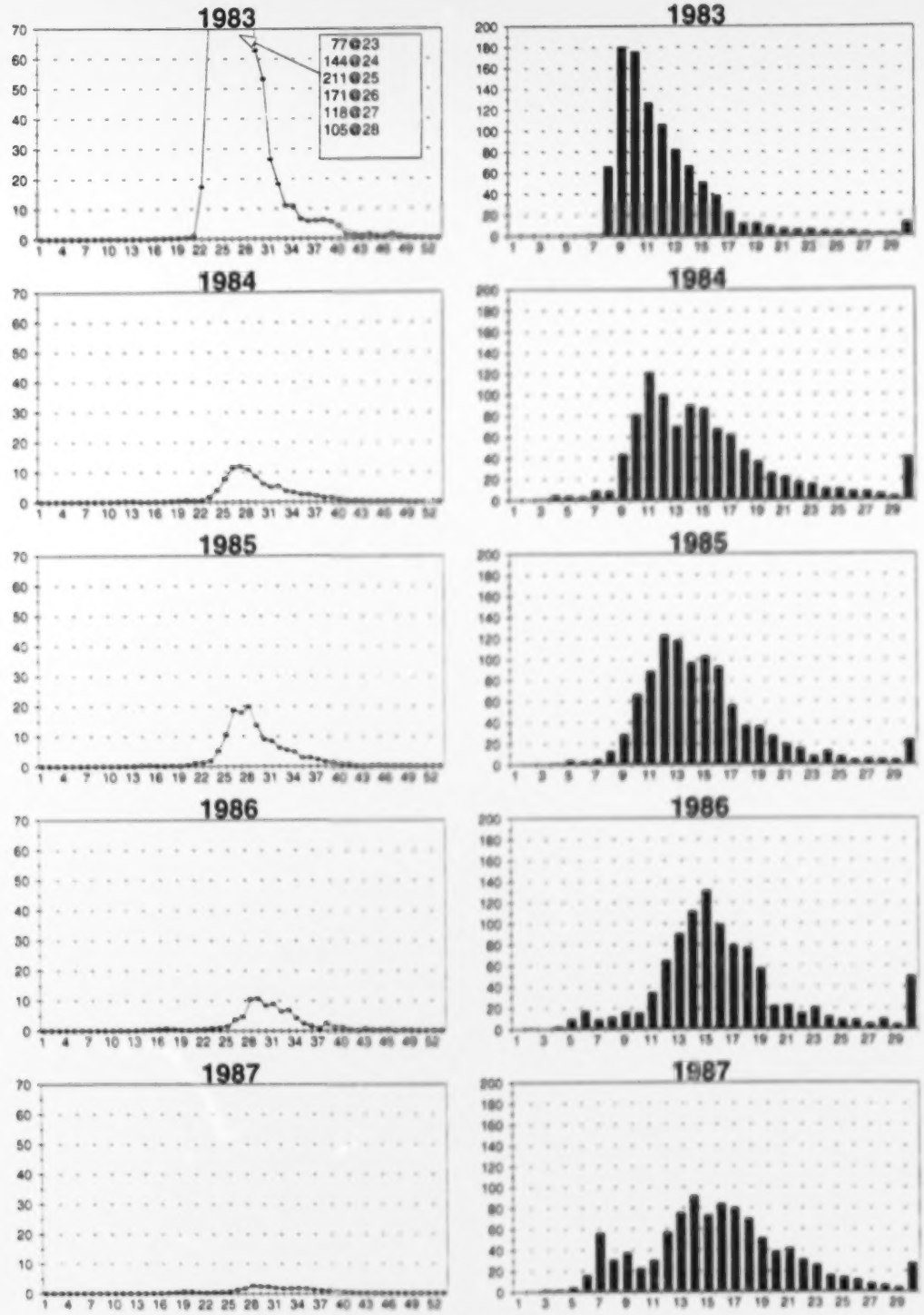

Fig. 4. (continued)

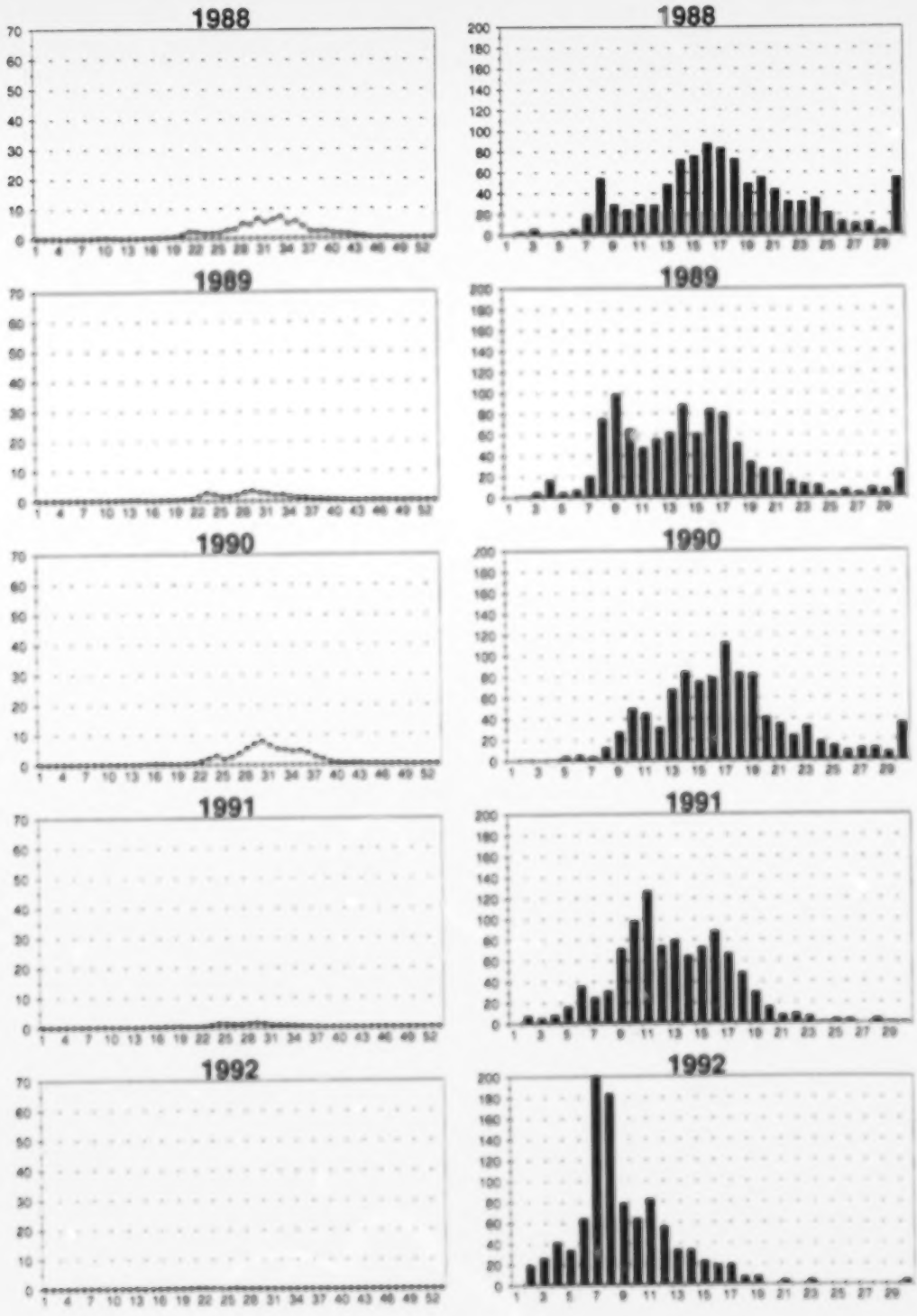

Fig. 4. (continued)

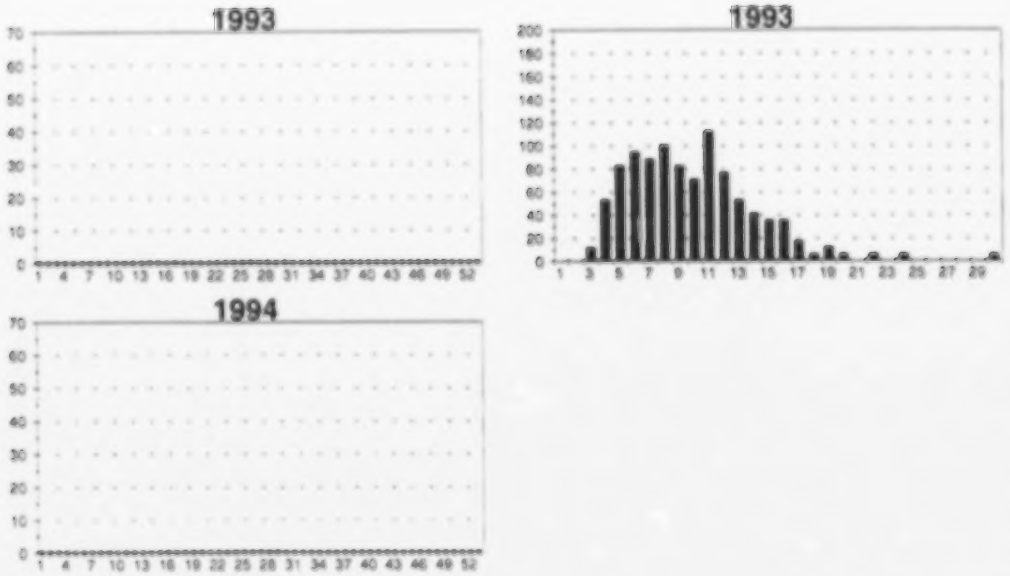

Fig. 4. (continued)

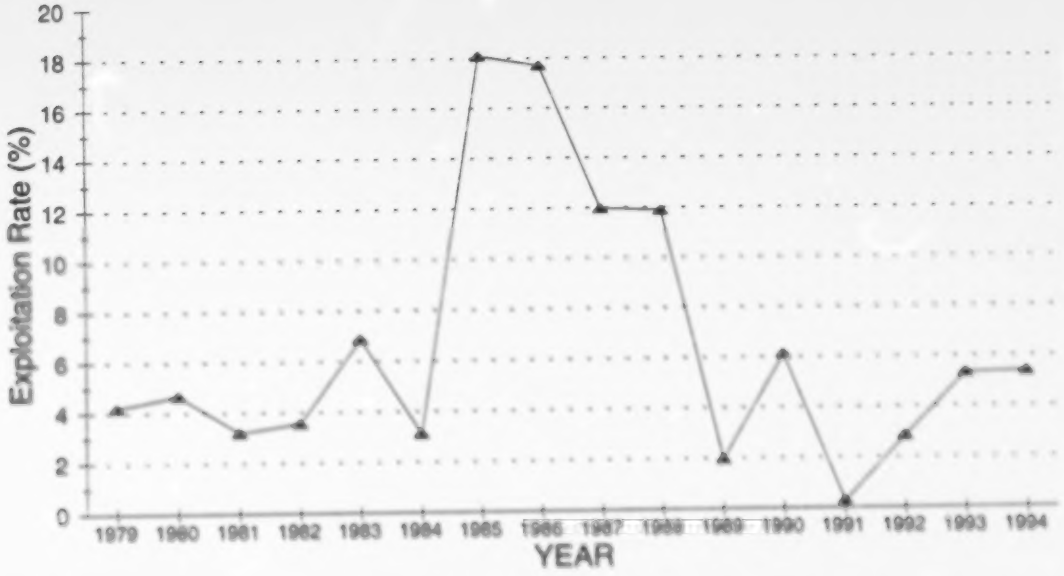

Fig. 5. Estimates of exploitation rate derived by calculating a ratio of catch in year 'x' in Division 2J3K to trawlable biomass in year "x-1" from fall surveys.